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Examiner : Kelly J. Mahafkey
Applicants : Cheree L. B. Stevens et al.
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For : **EXTERNAL COATING COMPOSITION FOR TOASTER
PASTRIES AND OTHER PASTRY PRODUCTS**

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DECLARATION OF JOHN STEVENS

I, John Stevens, do hereby declare as follows:

1. I am the Vice President for Research and Development for Advanced Food Technologies, assignee of the present patent application. I graduated from Cornell University with a Food Science Degree in 1970. I have had over 30 years experience in the food science industry. I have had extensive experience specifically in the food coatings area for 14 years, since 1989.

2. From 1989 to 1991, I was the Research and Development Manager for Universal Foods Corporation, where I directed coated french fry developments which resulted in 60 million dollars in additional annual sales for the company. I developed the first clear coat French fry, now having estimated market sales of over 1 billion pounds per year.

3. From 1991 to 1994, I was Director of Technical Services for McCain Foods, Inc. I directed all of the potato food coatings research for McCain Foods, Inc., including the development of marketed coatings.

4. From 1994-1996, I was the Research Manager for Miles Willard Company, directing all frozen and non-snack dehydrated potato development, including the development of a patented clear coat French fry product.

5. From 1996-1999, I was the Director of Northwest Region Technical Services for Newly Weds Foods, Inc. I established, staffed and directed all formula, process, specification, and commercialization of seasoned and clear coat French fry batters for all French fry processors and chain accounts throughout the United States. I developed and commercialized a signature clear coat french fry for a major processor and for a major national chain account.

6. From 1999 to date, I have served as the Vice President of Research and Development for Advanced Food Technologies, Inc.

7. I am one of the named inventors on United States Patent Application Serial Number 10/629,991.

8. I have reviewed the Office Action mailed January 26, 2006 in U.S. Patent Application Serial No. 10/629,991. I have also carefully reviewed WO 94/21143 to Baur et al., which is a referenced cited therein.

9. It is my opinion that the food product glaze composition disclosed in the Baur et al. reference would not sufficiently adhere to wheat-based dough substrates, including pastry products. This is due to the fact that the Baur et al. reference contains wheat flour as one of the essential components of the coating. Wheat flour components, as used in a coating composition applied to a wheat-based dough substrate, prevents the successful adherence of the coating.

10. It is also my opinion that wheat flour containing coatings, when applied to a wheat-based dough substrate, create a flaky, raised and visible coating, i.e. not a substantially clear coating.

11. All statements made herein of my own knowledge are true and all statements made on information and belief are believed to be true, and further, these statements are made with the knowledge that willful false statements and the like are punishable by fine or imprisonment, or both, under 18 U.S.C. § 1001, and that such willful false statements may jeopardize the validity of this application or any patent issued thereon.

July 26, 2006
Date

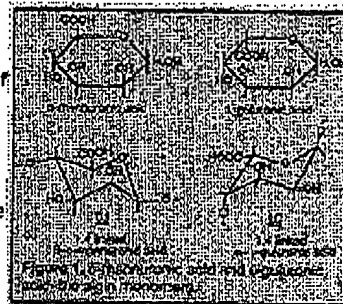
John Stevens
John Stevens

EXHIBIT 1

The Algin/Calcium Reaction

The term algin is used to describe alginic acid and its various inorganic salt forms, which are derived from brown seaweeds (*Phaeophyceae*). The monovalent salts, often referred to as alginates, are hydrophilic colloids and these, especially sodium alginate, are widely used in the food industry. In a great number of food applications, the now well-known reactivity of alginates with calcium ions is utilized. Although this reaction has been known for almost a century, its true potential as a structuring agent for food systems has not yet been fully realized. The purpose of this brochure is to highlight the "state of the art" in the application of the algin/calcium reaction in structured foods and, in so doing, provide a strong technical base from which new product opportunities can evolve. Since sodium alginate is the normal starting material for this reaction, the terms alginate and algin can be taken for the purposes of the discussion to be synonymous with sodium alginate.

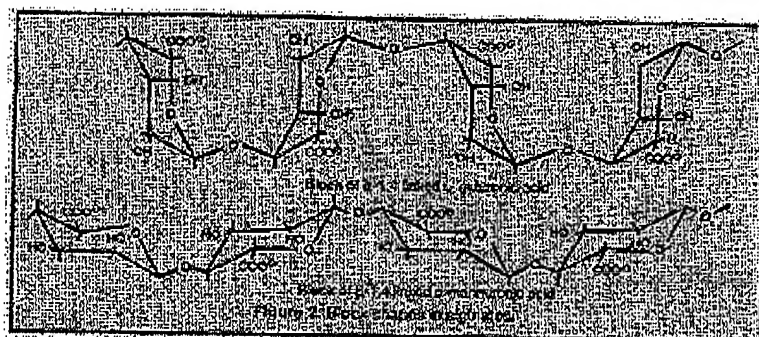
Alginate is a linear co-polymer composed of two monomeric units, D-mannuronic acid and L-guluronic acid. These monomers occur in the alginate molecule as regions made up exclusively of one unit or the other, referred to as M-blocks or G-blocks, or as regions in which the monomers approximate an alternating sequence. The calcium reactivity of alginates is a consequence of the particular molecular geometries of each of these regions. The shapes of the individual monomers are shown in Figure 1.



The D-mannuronic acid exists in the 1C conformation and in the alginate polymer is connected in the β -configuration through the 1- and 4-positions; the L-guluronic acid has the 1C conformation and is α -1, 4-linked in the polymer. Because of the particular shapes of the monomers and their modes of linkage in the polymer, the geometries of the G-block regions, M-block regions, and alternating regions are substantially different. Specifically, the G-blocks are buckled while the M-blocks have a shape referred to as an extended ribbon, as shown in Figure 2. If two G-block regions are aligned side by side, a diamond shaped hole results. This hole has dimensions that are ideal for the cooperative binding of calcium ions.



When calcium ions are added to a sodium alginate solution, such an alignment of the G-blocks occurs; and the calcium ions are bound between the two chains like eggs in an egg box, as shown in Figure 3. Thus the calcium reactivity of algin is the result of calcium-induced dimeric association of the G-block regions. Depending on the amount of calcium present in the system, these inter-chain associations can be either temporary or permanent. With low levels of calcium, temporary associations are obtained, giving rise to highly viscous, thixotropic solutions. At higher calcium levels, precipitation or gelation results from permanent associations of the chains. The structured foods discussed in this brochure utilize alginate gelation.



Commercial alginates are derived from a variety of weed sources. Since different weeds yield alginates that differ in monomeric composition and block structure, a given alginate has its own characteristic calcium reactivity and gelation properties. Although the ratio of mannuronic acid to guluronic acid (M:G ratio) can be obtained relatively easily, the detailed molecular compositions of alginates in terms of block lengths and block distributions are much more difficult to determine. As a result, alginates are usually referred to as "high M" or "high G", depending on the proportions of mannuronic acid and guluronic acid they contain. Most commercial products are of the high M type, the best example being the alginate obtained from giant kelp, *Macrocystis pyrifera*, which we harvest off the California coast. *Laminaria hyperborea* provides a high G alginate and is utilized by our alginate manufacturing plants in Scotland. In general terms, high G alginates produce strong, brittle gels that are heat stable, while high M alginates provide weaker, more elastic gels that have less heat stability but more freeze/thaw stability. Final gel strength, however, can be adjusted by manipulation of the gel chemistry and in some product situations, high G and high M alginates are interchangeable.

In practice, alginate gels are obtained using three major methods; namely, diffusion setting, internal setting, or setting by cooling.

Diffusion Setting:

Diffusion setting is the simplest technique and, as the term implies, the gel is set by allowing calcium ions to diffuse into an alginate solution. Since the diffusion process is slow, this approach can only be effectively utilized to set thin strips of material (e.g., pimiento strips, films, coatings, etc.), or to provide a thin gelled coating on the surface of a food product such as an onion ring. The diffusion rate can be increased by increasing the calcium concentration in the setting bath. This has limitations, however, since calcium chloride, the most common source of calcium ions for diffusion, imparts an unpleasant taste to foods when used at high levels. Also, calcium lactate, another setting agent, has a relatively low solubility (ca. 5 percent by wt.) in water.

Internal Setting:

In internal or bulk setting, which is normally carried out at room temperature, the calcium is released under controlled conditions from within the system. Although the detailed reaction kinetics are extremely complex, involving both high molecular weight polymers and small organic and inorganic molecules, a qualitative understanding of the reaction, sufficient for practical purposes, has been acquired. This has led to the development of structured fruits, structured pet foods, and a host of cold prepared desserts. Calcium sulfate (usually as the dihydrate), gypsum, and dicalcium phosphate (calcium hydrogen orthophosphate) are the sources of calcium most commonly used. The rate at which the calcium is made available to the alginate molecules depends primarily on pH and the amount, particle size and intrinsic solubility characteristics of the calcium salt. Small particle size and low pH favor rapid release of calcium.

In most situations, calcium release during the mixing of the ingredients is so rapid that a calcium sequestrant is required to control the reaction by competing with the alginate for calcium ions. Typical food-approved sequestrants are sodium hexametaphosphate, tetrasodium pyrophosphate, and sodium citrate. Although disodium phosphate (disodium hydrogen orthophosphate) has little affinity for calcium at pH less than 5, it is sometimes usefully employed in the preparation of alginate gels to remove (as insoluble dicalcium phosphate) calcium ions from tap water. Removal of these ions permits more efficient hydration and subsequent gelation of the alginate.

For a given level of alginate and calcium salt, an increase in the level of sequestrant causes a decrease in the setting rate of the gel. This results in a progressively weaker final gel, since the ultimate distribution of the calcium ions between the alginate and the sequestrant increasingly favors the latter. In other words, the so-called conversion of the sodium alginate into the gelled calcium form is progressively reduced. Control of the gelling reaction with sequestrants is only necessary during mixing to prevent premature

gelation and irreversible breakdown of the gel structure. Obviously, with highly efficient and rapid-mixing equipment only a relatively small amount of sequestrant is required because only a small proportion of the calcium salt has the opportunity to dissolve during the mixing process. In these situations, extremely fast setting, strong gels are obtained.

Setting by Cooling:

The third method of preparing alginate gels involves dissolving the gelling ingredients, alginate, calcium salt, acid, and sequestrant in hot water and allowing the solution to set by cooling. Unlike gelatin gels, these alginate gels are not thermo-reversible and can be used as desserts in countries where the ambient temperature is sufficiently high to melt gelatin gels. The calcium salts and sequestrants used in this system are the same as those already mentioned for internal setting. Although the calcium ions required for the setting reaction are already in solution with the alginate, setting does not occur at elevated temperatures because the alginate chains have too much thermal energy to permit alignment. It is only when the solution is cooled that calcium-induced inter chain associations can occur.

An interesting feature of this type of gel is its stability - syneresis or water loss from the network is minimal. This stability is due to the fact that the calcium required for gel formation is available in solution to all of the alginate molecules at the same time, allowing the formation of a thermodynamically stable network.

In contrast, in diffusion setting the algin molecules closest to the calcium ions in the setting bath react first, and in internal setting the molecules closest to the macroscopic particles of dissolving calcium salt react first. In other words, in these two systems, the molecules do not have the opportunity to align all at the same time, and the resulting gel networks have a certain amount of built-in instability. This instability gives rise to some gel shrinkage and syneresis. In certain product situations, steps must be taken to ensure that shrinkage and syneresis are maintained at an acceptable level.

The above discussion covers the basic principles of the algin/calcium reaction. The following sections illustrate the practical applications of this reaction.

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EXHIBIT 2

Starch Gelatinization


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Factors Affecting Starch Paste and Gel Strength

Starch is an important constituent in many foods. It plays an obvious role in achieving the desired viscosity in such products as cornstarch pudding, sauces, pie fillings and gravies. It plays a more subtle role in potatoes, cereals, and baked products such as biscuits, muffins, popovers, pastry, cake and bread. Because of the importance of this food constituent, it is important to understand more about it.

Starch occurs in the leucoplasts of tubers, leaves, seeds and other portions of the plant. Scanning electron micrographs (SEM) shows leucoplasts in a typical cell.

Further chemical and microphotography techniques has elucidated that starch is composed of two polymers - amylose and amylopectin. Scanning electron micrographs representing aggregates of these two polymers. Because of SEM limitations, SEM likely does not represent the actual individual glucose polymers; but rather, are probably conjugated macropolymers with a considerable amount of intermolecular bonding.

Amylopectin is the branched chained glucose polymer containing both alpha - 1, 4- linear and alpha - 1, 6-branched linkages. At one time, we used to say that this branched bushy polymer with branches 20 to 30 glucose residues long, contributes primarily to the viscosity of a prepared food. This was contrasted to the gelling contribution of the alpha - 1, 4 linked linear polymer - amylose. Amylose is approximately one-fourth the size of amylopectin; however, the glucose residues are 400 to 4000 units long. The attributing of viscosity to amylopectin and gelling to amylose may not be entirely valid.

The many different starches range in amylose, on the average, from 16 to 25% and maybe as high as 30%. You know there are some high amylose rice starch which may have as much as 80 to 90% amylose. These starches are unusual and are occasionally used in edible casings. At the other end of the scale, there are the waxy corn starches, waxy rice starches, and although not listed in the table, waxy sorghum, which contains 100% amylopectin and no amylose.

The amount of amylose may be defined in terms of iodine affinity. Measuring the amount of iodine in terms of iodine absorption by the amylose helix is a traditional approach. Amylose will form a complex with iodine turning a bluish color, amylopectin will not turn blue but rather a dispersion will maintain a reddish-brown color. In an institutional food service situation, this difference could be used to check out the possibility of added cereals to ground meat. There are other approaches to starch content and composition - for example, solubility or enzymatic techniques.

During the plants development photosynthesis takes place in the chloroplasts. From the transient starch synthesized in the chloroplasts, the starch is stored in the amyloplasts in the form of granules. These granules are generally either small and spherical or large and ellipsoidal. Within the granules the starch polymers are layered down in an organized manner. The manner of granule development varies for the different starch sources. It is possible to show the shape of at least four starch granules. The round spherical, somewhat angular corn starch granules can be seen. The variation in shape may be due to packing of the granules in the endosperm during development. Arrow root starch granules are somewhat ellipsoid in shape. The distinctive nature of each variety of starch can be seen. These are among the smaller granules of starch. The granules appear Polygonal and are in clusters. Possibly because of the small granule size, separation of the starch during processing may have been difficult and inadequately done. Waxy maize starch granules have a greater variation than the corn starch. Additionally, there is some observable graininess.

Not all starch occurs in purified form for use in foods. Wheat starch granules appear to be



two sizes, a large lenticular shaped granule and small spherical granules with intermediary sizes. Although surfaces are relatively smooth, the granules show depressions, possibly due to either packing in the endosperm or extraction during processing, non-spherical or lenticular portions in the wheat flour may be flour protein.

In order to withstand modern processing and storage conditions, native starches are chemically or physically modified to chance their properties. Modification is usually done to develop characteristics for specialized purposes by mild degradation, crosslinking of chains, derivatizing with phosphate or other esters or pregelatinization of the starch. Purity W has been modified by cross-linking waxy maize. This has increased its cold temperature stability, making it particularly useful for frozen products. The appearance of this modified starch, Purity W, is not greatly dissimilar from the native waxy maize. A difference was noted at higher magnifications. A greater number of pinholes were noted in the modified Purity W, possibly a result of the process or refining to obtain a whiter product. The Nesco gel starch is a wheat starch which has been pregelatinized to permit usage at lower heating temperature than usual with nongelatinized wheat starch. This pregelatinized wheat starch shows considerable deformation. On closer examination at a higher magnification, these granules appear to be collapsed with some sticking of the granules to each other.

The raw corn starch is frequently analyzed raw or as to the degree of change within the granule when heated in a starch-water dispersion.

A pictorial representation of the effect of heat at 8 endpoint temperatures on a basic five percent starch-water system indicates how changes may be seen by photomicrographic techniques. A five percent dispersion of starch approximates the concentration typical for some starch-containing gravies, pudding, soups and other entrees.

Summarizing the changes in the granule structure starting at 30C in the upper left hand corner and moving to 50C in the upper right hand corner. The represented end point moves downward from left to right at 60, 65, 70, 75, 80 and 85C. As shown, the granule progressively loses its integrity as the endpoint temperature increases. At 60C, there is a slightly noticeable change in the granule appearance. There is some dimpling and a few doughnut-shaped granules. As might be expected from viscosity increase and loss of birefringence this is more pronounced at 65C. At 75 and 80C there appeared to be collapse and deformation. At 85C considerable fragmentation and loss of granule integrity occurred.

In word form, this link summarizes some changes occurring within the starch granule. Of course, these changes likely occur at different temperatures for different starch sources.

In greater detail, in looking at corn starch-water starch dispersions during heating we find that from 30 to 50C there is essentially no change in the appearance of the granules. In this range, the granules are still held together by inter- and intra-molecular hydrogen bonding within and between the amylose and amylopectin. Although few changes are observable, with temperature increase hydrogen bonds are weakened and absorption of water within the granule is facilitated. Between 50 and 65C there is a slight to noticeable change in granule appearance. There is some dimpling and a few doughnut-shaped granules. At 70C the Gelatinization process may be extensive. At 75 and 80C there appears to be the collapse, deformation and loss of granule definition.

These changes not only differ with starch source but may differ with various temperature - time combinations. There is a range of heating temperatures at which food starch granules begin to lose their organized structure.

This slide shows micrographs of wheat starch - water dispersion at 30, 55, 80 and 85C moving from the upper left hand corner to upper right hand corner. As expected, the granules swell at a lower temperature than did the cornstarch. The observable changes begin to occur at 40 to 50C. At 55C, gelatinization of starch is visualized as a swollen granule with considerable exudate on the exterior. Contrary to the historical view of amylopectin being responsible for viscosity and amylose for gel strength, Miller et al. (Miller, B.S., Derby, R.I. and Trimbo, H.B. 1973. A pictorial explanation for the increase in

viscosity of a heated wheat starch-water suspension. Cereal Chemistry 60:271) observed the exudate stained blue with iodine and contributed to viscosity. Amylose also stains blue in unmodified starches and the hydrophilic nature of its polymer would contribute to viscosity. In addition to exudate shown in the wheat starch-water dispersion, a similar exudate is seen with heated corn starch - water dispersion.

Swelling power is a technic used to define changes in starch during heating of a dispersion. The contrast between an unheated granule at 30C and heated granule at 80C can be seen in this slide.

Enzymes do hydrolyze and isomerase starches. There are many common carboxylases used in food preparation and food processing. One important enzyme to the starch industry that is not listed here is the fructose isomerase. One portion of the industry uses amylases to hydrolyze starch to glucose units and then isomerizes the glucose to the sweet fructose.

This sweet fructose is a FDA approved substitute for sucrose. As starch granules become more gelatinized they become increasingly susceptible to the action of amylases. This slide shows such a relationship.

Sedimentation of the granule also is related to gelatinization of the granule. This slide shows this relationship.

Viscosity is a property also used to define degree of gelatinization. Additionally, of course, this is an extremely important property in terms of food quality. The Brabender Visco/Amylo/Graph not only permits the recording of the viscosity of a heated starch-water dispersion but permits the charting of changes in viscosity over a controlled temperature rise. That is, the Brabender amylograph will heat and cool a starch-water dispersion 1.5C/minute until it reaches the programmed endpoint temperature. It records the increased viscosity required to stir the heating dispersion on a graph, such as seen in this slide. Of course, different starches have different viscosities requiring different forces and yields different graphs.

A number of factors do influence the viscosity, and that other important property, gel strength, as well as that of gelatinization. Heating rate will influence these two properties - viscosity and gel strength. When starch is heated at 100C versus 200C the heating rate differs in the two starch-water dispersions heated at 100 versus 200C. As expected, that starch-water dispersion heated at 200C has a steeper curve than that heated at 100C. Interestingly, dispersions of wheat starch appears to heat faster than corn starch. Interestingly, wheat starch-water dispersions are less viscous than those made with corn starch.

In comparing two corn starch-water dispersions heated to 85C at 100C, or 200C the slower - heated, starch appears to have more exudate and granule deformation. Although some exudate and deformation is present in the samples heated rapidly, the granules appear to have more tearing and fragmentation. Additionally, the exudate appears to be less uniformly exuded from granules. Similar results are shown in the lower portion of the slide with the wheat starch. Again, the rapidly heated wheat starch - water dispersion granules were more fragmented, concaved and deformed with some filamentous materials. Results shown in this slide indicate the need for a considerable more investigation.

There are two primary objective simple procedures of evaluating gel strength and viscosity. In addition to determining viscosity by Brabender Visco/Amylo/Graph, a crude technic of the linespread test may be used or other processes such as the Brookfield viscometer. Gel strength may be determined with the penetrometer, as shown here, or the percent sag test. With both viscosity and gel strength one is concerned with both gelatinization and retrogradation, respectively.

Retrogradation is due to realignment of the glucose polymers, primarily amylose. It may show up physically by a decrease in starch solubility and an increase in opaqueness. Retrogradation, once it is initiated after removal of a gelatinized starch-water dispersion from the heat, may form a semirigid structure at room temperature. This link diagrams the

organized raw starch granule structure to the organized starch gel. Of course, the intermediary disorganized starch granule during gelatinization is not shown. This disorganized gelatinized structure can be seen in this slide.

The degree of disorganization is dependent upon partially upon the cooking process. Differentiating between gelation and viscosity is somewhat difficult. This is especially true with conventional versus autoclaved dispersions.

Graphs from the amylograph shows the stirring or shearing action influences viscosity. This complicates the differentiation between those two properties viscosity and gelation. In order to form a gel and have gelation occur a number of variables must be controlled. Temperature is one of these variables. If we cool the starch too fast, such as in a freezer, we are going to get a very loose type of alignment of the amylose and amylopectin resulting in a weak gel. If we cool too slowly there will be considerable alignment and again a poor gel with a lot of syneresis. This link shows a scanning electron micrograph of a gelled starch dispersion with possible interaction shown.

To reiterate, this slide shows a five percent corn starch - water dispersion heated to 90C. If the dispersion is frozen and defrosted we may get a starch-water dispersion such as shown in this slide. It is well documented that freezing of gelatinized starch-water dispersions will cause a change in quality. This slide shows the effect of the freeze-thaw cycle on one quality parameter-syneresis. Different native and modified starches show differences in stability.

In the expanding market for frozen entrees, we are concerned with both the freeze-thaw stability and the effect of reheating stresses. The next three show scanning electron micrographs of a frozen and waterbath reheated 10% wheat starch. As you note there are pocked-marked structures. This pockedmark or honeycomb arrangement may be due to gelation of the starch dispersion during freezing. These three views of the identical starch dispersion indicates one of the problems of scanning electron micrograph interpretation. Many micrographs must be viewed before making general statements.

The effect of freezing and reheating of a corn starch-water dispersion may be viewed in SEMs. Again, one can observe the honeycomb appearance. In comparing that dispersion frozen and reheated in a microwave oven versus that reheated in a waterbath a difference can be seen. The tighter more crystalline appearance of the microwave as compared to the waterbath may be due to the time-temperature relationship and partial reversal of retrogradation.

Not only the effect of variety, but the influence of both temperature of gelatinization and interaction of added ingredients or granule structure during preparation, freezing and reheating, high quality, frozen, starch-containing prepared foods can be developed from both native and modified starches. Two starches in a simple system which are also used in a cream of cheese soup concentrate. The Purity W granules are similar to the raw granules. Purity W granules generally appear to be round with a variety of sizes; whereas the wheat flour granules shown in the lower left-hand corner are disk-shaped or small and round. When the modified cross-linked, Purity 14 was added to 83C redistilled water considerable swelling took place. Also note the exudate which maybe amylose. Although not as pronounced, similar results with the starch granules occurred when the wheat flour was added to the 83C redistilled water. Upon holding for 15 minutes, the wheat flour dispersion has a much greater deformation and loss of granule integrity. This next slide shows the effect of processing on a cream of cheese soup. At an intermediary step in processing you see, in the Upper left hand corner, a definite granule structure with very few damaged granules. Both large and small granules are present. The large-disc shaped granules are probably wheat starch granules from the flour and the small either the small, round or oval wheat starch granules are either the small, oval wheat granules and/or cross-linked waxy maize from Purity 1W. As you see, with further processing and freezing and reheating it is increasingly difficult to distinguish the granule structure as there is greater deformation. These scanning electron micrograph results can be related to sensory scores. Notice in this Table how there is more syneresis, a thinner runnier soup, and poorer over all and texture acceptability with freezing and reheating. In order to assure optimum quality for frozen entrees it is apparent more work must be done.

It is apparent to all those who work with foods that each one of the starches shown in the SEMs here has its own characteristics, stability, and contribution to the foods overall properties. For example, translucency will vary for different starches. These starches are frequently used in pie fillings and thus, translucency may be an important characteristic.

Many ingredients will influence the properties of a heated starch-water dispersion. Some of the primary ingredients used in foods that influence the ultimate paste viscosity and gel strength are: acids, sugar, fat, eggs and milk. Generally, these ingredients affect the two properties by either their effect upon the gelatinization of the granule or their disruption or hydrolysis of the glucose polymers amylose and amylopectins. In a complex food system both influences may occur.

In a discussion of the effects of fats on the swelling of starch Granules and the resulting viscosity changes, a distinction must be made between fats, emulsifying agents and free fatty acids. In looking at the next three slides we see that there appears to be an inhibition of swelling. This decrease in swelling can bring about a lowered viscosity and decreased gel strength. Fats without emulsifying agents and free fatty acids neither increased or decreased the maximum viscosity that was obtained when mixtures were heated in the Brabender Visco/Amylo/Graph; however, all had the same effect in lowering the temperature at which the maximum viscosity was reached. If monoglycerides, diglycerides or free fatty acids are added there does appear to be a complexing on the granule surface and decreased viscosity and gel strength.

Fat is not only found as an added ingredient for white sauces and gravies, but, it may also be found in the chocolate for chocolate pudding. A more subtle role of fat would possibly be its influence on starch in a number of baked products.

In evaluating the effect of a number of ingredients upon gelatinization and gelation of starch we can describe differences in a variety of puddings. We know these are not only influenced by the presence or absence of fat, but also by salts, sugars, milk and its components and acids.

This table shows the influence of a variety of sodium salts on the amylograms of starch dispersions. The higher the values, the more viscous the dispersion. At the present time, in most foods, the concentration of the salt in the food is likely so low that their effect is probably not as great as the other ingredients in the food. However, as can be seen from the table, their effect can not be ignored.

Sugars impede the swelling of the starch granule. As can be seen in this graph, different sugars have different influences. The sugar is apparently competing with starch for the water. The retardation of the swelling and extension in the gelatinization range may result in both decreased viscosity and gel strength. If as much as 50% sucrose is added to a dispersion no gel will actually form, a 10% addition weakens the gel. Note from the graph that sucrose and lactose, two disaccharides, appear to have a greater influence than the monosaccharides.

Lactose is found in milk. It is thought the protein constituent of milk and other ingredients also affect the starch properties in some way.

Dextrinization of starch may occur in food items due to either enzyme, heat or acid/alkali stress. Dextrinization is the hydrolysis of the long polymer of glucose residues into shorter chain lengths generally resulting in decreased viscosity and gel strength. Although enzyme dextrinization may occur in the preparation of yeast products, acid and heat dextrinization are more common. The classic example often cited for acid dextrinization is that which occurs in a lemon pie filling. In order to minimize syneresis or souppiness due to dextrinization, the juice is often added at the latter cooking phase. Dextrinization of a starch dispersion below pH 2.5 and above pH 10 will usually occur. It is generally a lesser problem in the pH 4.0 to pH 7.0 range.

Updated: Friday, May 26, 2006.